REMARKS

Reconsideration of this application, as amended, is respectfully requested.

Claims 1-26 and 28-41 are pending. Claims 1-4, 6-8, 28, 32-35 and 39-41 were rejected. Claims 36-38 were objected to. Claims 5, 9-27, and 29-31 were withdrawn. Claim 27 has been canceled.

In this response, no claims have been amended. No claims have been canceled. No claims have been added.

Support for the pending claims 1-26 and 28-41 is found in the specification, the drawings, and in the claims as originally filed.

Applicantsreserves all rights with respect to the applicability of the Doctrine of Equivalents.

Applicants acknowledge with appreciation the Examiner's indication of allowance of claims 36-38 if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 1, 3-4, and 6 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,241,358 to Wade ("Wade").

Claim 1 reads as follows:

> A semiconductor device, comprising
> a substrate having a surface,
> a first *pn*-junction defining a first depletion region formed on said substrate at a first depth relative to said surface,
> <u>a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth,</u>
> <u>a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions,</u>
> <u>said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in</u>

response to light of a third wavelength band incident on said surface,

doped drain and source regions on said substrate in communication with said channel;

first and second electrical interconnects in communication with said source and drain regions, respectively; and

third and fourth electrical interconnects in communication with said first and second *pn*-junctions, respectively;

whereby incident light on said surface at said first, second, and third wavelength bands are detectable through currents through said first, second, third and fourth electrical contacts.

(Claim 1)(emphasis added)

Wade discloses shortening the turn-off time of a radiation sensitive device with lateral current. More specifically, Wade discloses a junction between radiation sensitive element 14 and semiconductor layer 12 is used for producing the photocurrent (Figure 2, col. 3, lines 39-44). In fact, Wade discloses only a single junction used to generate a photocurrent in response to incident light, which is the junction between the p-type radiation sensitive element 14 and the semiconductor layer 12. The junction between region 12 and 34 of the semiconductor device of Wade (Figure 2) are not used for photo conductivity. In contrast, claim 1 refers to a second depletion region formed on a substrate at a second depth relative to a surface deeper than a first depth of a first depletion region to generate charge carriers in the second depletion region in response to light of a second wavelength band incident on the surface, as recited in claim 1. Wade fails to disclose a semiconductor device having a second *pn*-junction defining a second depletion region formed on a substrate at a second depth relative to a surface and deeper than a first depth of a first *pn*-junction, wherein the first depth is chosen to generate charge carriers in the first depletion region of a first pn-junction in response to light of a first wavelength band incident on a surface, and wherein the second depth is chosen to generate charge carriers in the

second depletion region of the second *pn*-junction in response to light of a second wavelength band incident on said surface, as recited in claim 1.

Furthermore, Wade fails to disclose a doped, photo-conductive channel formed on substrate between a first pn-junction at a first depth, and a second *pn*-junctions at a second depth deeper than the first depth, as recited in claim 1. Wade at best describes only a lateral flow of carriers in the semiconductor layer 12 to create a bias current to sweep the semiconductor layer 12 of excess carriers to enable rapid switching, e.g. for shortening turn-off time. These areas have no active role in photo detecting. Moreover, region 34 is not formed on a substrate ***between*** the first and second junctions. Simply put, if the Examiner considers the junction between region 12 and 14 as the first junction and junction between the region 14 and 34 as the second junction, then there can be no channel as claimed. If region 12 is contemplated as amounting to the channel region, then there can be no second junction.

Moreover, Wade fails to disclose a doped, photo-conductive channel formed on substrate between a first pn-junction at a first depth, and a second *pn*-junctions at a second depth deeper than the first depth, wherein the first depth and second depth are chosen to generate charge carriers in the channel photo-conductive channel in response to light of a third wavelength band incident on the surface, as recited in claim 1. It should be importantly noted that depths of first and second junctions, if they are even present in Wade, are not chosen to generate charge carriers in the channel in response to light of a third wavelength band incident on the surface. The respective depths, as claimed in claim 1, are chosen as claimed to generate free charge carriers in the depletion regions and the conducting channel in response to light of different wavelength bands incident on the surface of a substrate (specification, paragraphs [0008]-[0012).

In stark contrast, Wade fails to disclose that the depth of the *pn* junction between the P-type radiation sensitive element 14 and the N-type conductive semiconductor layer 12 and the depth of the pn junction between the surface 26 and the substrate 34 are chosen to generate (free) charge carriers in the depletion regions and the conducting channel in response to light of different wavelength bands incident on the surface of a substrate.

Wade still further fails to disclose charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on the substrate in communication with the channel, as recited in claim 1.

Because Wade fails to disclose all limitations of amended claim 1, applicants respectfully submit that claim 1, as amended, is not anticipated by Wade under 35 U.S.C. §102(b).

Given that claims 3-4 and 6 depend from amended claim 1, and add additional limitations, applicants respectfully submit that claims 3-4 and 6 are not anticipated by Wade under 35 U.S.C. §102(b).

Claims 1, 3-4, 6, 32-35, 39, and 49 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,749,851 to Wolffenbuttel ("Wolffenbuttel").

Amended claim 1 reads, in part as follows: "a first *pn*-junction defining a first depletion region formed on said substrate at a first depth relative to said surface, a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, <u>photo-conductive</u> channel formed on said substrate between said first and second *pn*-junctions, <u>said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in</u>

response to light of a third wavelength band incident on said surface; doped drain and source regions on said substrate in communication with said channelfirst and second electrical interconnects in communication with said source and drain regions, respectively; and third and fourth electrical interconnects in communication with said first and second *pn*-junctions, respectively; whereby incident light on said surface at said first, second, and third wavelength bands are detectable through currents through said first, second, third and fourth electrical contacts." (emphasis added)

Wolffenbuttel discloses a method and circuit for determining the wavelength of the light. More specifically, Wolffenbuttel discloses a JFET structure and a channel current. The JFET of Wolffenbuttel, however, does not play a direct role in photosensing. According to Wolffenbuttel only the top gate junction is employed for photosensing. Wolffenbuttel's deficiencies are clearly indicated in FIG. 5 and in the description whereby, the purpose of the JFET is not to directly photosense, but rather to perform a secondary role. Indeed, Wolffenbuttel clearly states that the purpose of the JFET is to control the depletion zone: "To take care that no diffusion will take place from charge carriers out of the underlying epitaxial n layer into the depletion zone within the dotted line a, the part of the epitaxial layer underneath the dotted line a has to be depleted completely. For that reason the voltage of the voltage source V2 has to be adjusted such that the thereby created second depletion zone extends from the substrate 10 upwards to the dash-dot line f. " (col. 6 line 52).

In other words, rather than using the complete JFET structure to perform complete colour sensing, as in the claimed invention, the JFET of Wolffenbuttel is constantly operated at the point of pinch-off (see Wolffenbuttel column 6., lines 62 & 67-68). As a result, only photo generation that takes place in the depleted region of the depleted region of the top gate junction

contributes to the detected current. During pinch off as described beginning at col. 7, line 2, the detected current "will only be caused by (1) charge carriers generated by the impinging photons in the depletion zone within the dotted line a and (2) charge carriers which will be generated by the impinging photons in the p region 13 and diffusing into the depletion zone bounded by the dotted line a.". It can therefore be seen that the JFET of is Wolffenbuttel is merely a control element ancillary to the operation of colour sensing. Wolffenbuttel describes at col. 6, lines 28-30 that "By means of the current/voltage-converter 22 the current through the JFET is measured and depending on this current, and the corresponding voltage, a control signal for the voltage source V2 is generated". Because the device of Wolffenbuttel, such as that shown in FIG. 5 does not simultaneously detect all colour signals, and is "tuned" to a single colour range, in order to ensure colour detection in a different range, the bias value V3 must be changed, as clearly indicated at col. 7, line : "Thereafter the voltage of the source V3 is adjusted by the signal source 23 to a second predetermined value ... ."

Such an approach is disadvantageous. First by applying different values for the V3 bias value, the color range is not selected but rather only broadened. Because the 1st photosensing depletion region will be included within the extended boundaries of the 2nd photosensing depletion region, the colour range detected in the 2nd case based on a new bias value for V3 would not be completely different from that detected previously for the previous bias value of V3. In an extreme case, all depths would be detected by the same sensing junction leading to reduced selectivity. Still further, if different values are required to be set, it must necessarily follow that the detection of different colour ranges occurs as a sequential operation in time.

Accordingly, the device shown in FIG. 5 of Wolffenbuttel cannot be considered a true colorimetric sensor, capable of immediately and simultaneously detecting and providing all the

RGB outputs of interest entirely within its own structure and without the need for complex signal processing associated with the control of V3 from which the entire wavelength information must be deduced. Further the variation of V3 in Wolffenbuttel must be of a sufficiently slow speed to allow for rapid signal processing and data calculations which would extract the necessary spectral information leading to distadvantages.

For to accomplish multiple color detection, Wolffenbuttel proposes the structures shown in FIG. 11 and FIG. 15, employing 3 different sensors, or FIG. 14 with 2 sensors, each for the detection of a different colour range. Because each sensor is biased by a different value of V3, exactly in order to circumvent the time-consuming sequential colour sensing of a single sensing unit, it is clear that Wolffenbuttel fails to disclose a semiconductor device having a second *pn*-junction defining a second depletion region formed on a substrate at a second depth relative to a surface and deeper than a first depth associated with a first pn-junction, as recited in claim 1.

Wolffenbuttel further fails to disclose a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, generate charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and generate charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel as recited in claim 1.

Furthermore, it should be noted that in view of the above explanation, the assertion that the absorption section has a pre-determined photo-conductivity spectral response and at least two depleted regions, is mischaracterized. The sections cited from Wolffenbuttel in page 6, item 14,

of the Office Action refer, not to "at least" two depleted regions, but to only two depleted regions. One region is of the top wavelength-sensing junction, and one of the bottom depleted region used by the JFET as a reference only to correctly determine the photogenerated current of the top junction and not for direct usage or contribution to an output as a colour-related signal. A casual review of any of the circuits shown in Fig.5-a, 11-a, 13-1, 14-a, 15-a and 16-a in Wolffenbuttel would immediately reveal to one of skill in the art that NO current colour signal is extracted from either the drain/source or the channel of the JFET. Instead, the devices are used only as feedback controls to the applied bias V3. It is important to note that Wolffenbuttel has not provided any evidence that charge carriers would be generated in a second depletion region in response to wavelengths incident on a second surface or in a channel based on wavelengths incident on a channel, as recited in claim 1.

Because Wolffenbuttel fails to disclose all limitations of amended claim 1, applicants respectfully submit that claim 1, as amended, is not anticipated by Wolffenbuttel under 35 U.S.C. §102(b).

Given that claims 3-4, 6, 32-35, 39, and 49 contain limitations that are similar to those limitations set forth above with respect to amended claim 1, applicants respectfully submit that claims 3-4, 6, 32-35, 39, and 49 are not anticipated by Wolffenbuttel under 35 U.S.C. §102(b).

Claim 2 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Wade in view of U.S. Patent No. 3,985,449 to Patrin ("Patrin").

As set forth above, Wade fails to disclose a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in

said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

Patrin, in contrast, discloses a photoelement comprising a semiconductor region 16 and an electrode 17 disposed on the surface of the oxide 15 over the semiconductor region (Figure 1). Patrin fails to disclose a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

It is respectfully submitted that none of the references cited by the Examiner teach or suggest a combination with each other. It would be impermissible hindsight, based on applicants' own disclosure, to combine Patrin and Wade.

Furthermore, even if Patrin and Wade were combined, such a combination would still lack a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and

second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

Given that claim 2 depends from claim 1, and adds additional limitations, applicants respectfully submit that claim 2 is not obvious under 35 U.S.C. §103(a) over Wade in view of Patrin.

Claims 7 and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Wade.

As set forth above, Wade fails to disclose a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

Therefore, given that claims 7 and 8 depend from claim 1, and add additional limitations, applicants respectfully submit that claims 7 and 8 are not obvious under 35 U.S.C. §103(a) over Wade.

Claim 28 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Wade in view of U.S. Patent No. 6,157,035 to Kuijk et al. ("Kuijk").

As set forth above, Wade fails to disclose a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

Kuijk, in contrast, discloses a spatially modulated detector for radiation. Kuijk fails to disclose a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

It is respectfully submitted that none of the references cited by the Examiner teach or suggest a combination with each other. It would be impermissible hindsight, based on applicants'

own disclosure, to combine Kuijk and Wade.

Furthermore, even if Kuijk and Wade were combined, such a combination would still lack a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

Given that claim 28 depends from claim 1, and adds additional limitations, applicants respectfully submit that claim 28 is not obvious under 35 U.S.C. §103(a) over Wade in view of Kuijk.

Claims 2, 7-8, and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Wolffenbuttel.

As set forth above, Wolffenbuttel fails to disclose a second *pn*-junction defining a second depletion region formed on said substrate at a second depth relative to said surface deeper than said first depth, a doped, photo-conductive channel formed on said substrate between said first and second *pn*-junctions, said first and second depths chosen to generate (i) charge carriers in said first depletion region in response to light of a first wavelength band incident on said surface, (ii) charge carriers in said second depletion region in response to light of a second wavelength band incident on said surface, and (iii) charge carriers in said channel in response to light of a

third wavelength band incident on said surface, doped drain and source regions on said substrate in communication with said channel, as recited in claim 1.

Given that claims 2, 7-8, and 28 depend from claim 1, and add additional limitations, applicants respectfully submit that claims 2, 7-8, and 28 are not obvious under 35 U.S.C. §103(a) over Wolffenbuttel.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If the Examiner believes a telephone conference would expedite the prosecution of the present application, the Examiner is invited to call the undersigned at (408) 720-8300.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,

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